(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 071 988**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 82107094.3

(22) Date of filing: 05.08.82

(51) Int. Cl.³: **B 01 J 19/00**, G 05 D 21/02
// B29H5/24

(30) Priority: 05.08.81 JP 123462/81
06.11.81 JP 178488/81
06.11.81 JP 178489/81
06.11.81 JP 178490/81
06.11.81 JP 178491/81

(43) Date of publication of application: 16.02.83
Bulletin 83/7

(84) Designated Contracting States: DE FR GB IT

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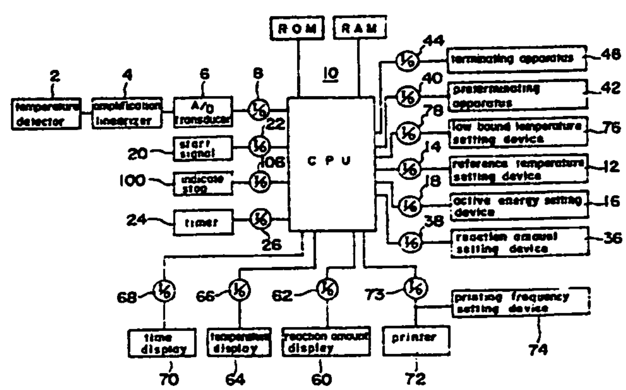
(54) **Apparatus for automatically measuring and controlling chemical reaction amount.**

(57) This invention is directed to a reaction amount measurement controlling apparatus capable of measuring the reaction amount with high accuracy and controlling the reaction amount. The apparatus comprises at least one temperature detector disposed in the interior, the outer surface of the reaction system or in a vessel, a computer having an operation function for calculating the reaction amount in accordance with the temperature signal of the temperature detector, and a comparison function for generating an output signal to terminate reaction when the reaction amount is equal to the preset amount or exceeds the preset amount, a timer for getting the operation and comparison performed at given intervals.



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"APPARATUS FOR AUTOMATICALLY MEASURING AND CONTROLLING CHEMICAL REACTION AMOUNT

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an apparatus for automatically measuring and controlling chemical reaction amount with respect to the subject materials such as reaction amount of rubber vulcanization reaction or high molecular material hardening reaction or the like.

Description of the Prior Art

Generally it is extremely important in chemical industry to control chemical reaction processes for the subject materials to improve reaction efficiency, product quality and yield ratio thereof. Thus, the present applicant developed a reaction amount measurement apparatus, which was capable of easily measuring the reaction amount in an operation field on the basis of controlling the reaction process as disclosed in the Japanese Patent Applications Nos. 22025/1979 and 162126/1980. In general, according to the Arrhenius reaction speed equation in the chemical reaction with respect to the subject materials, the ratio of the reaction amount, after

time t at temperature T in the reaction system, with respect to the reference reaction amount per time unit in the reference temperature To, i.e., the relative reaction amount (equivalence reaction amount) for the subject materials, is calculated by a microcomputer in accordance with the following equation (1) or equation (2) as its approximation equation so that the time lapse variation in the temperature measurement and the reaction amount can be expressed as follows:

$$U = \int_0^t e^{-\frac{E}{R}\left(\frac{1}{T} - \frac{1}{T_0}\right)} dt \qquad (1)$$

$$U = \int_0^t \alpha^{\frac{T-T_0}{10}} dt \qquad (2)$$

wherein U: equivalence reaction amount

E: active energy

R: gas constant

T: temperature

T_0: reference temperature

α: temperature coefficient

t: time

Actually the calculation by the above-described equation (1) or equation (2) is performed at constant time intervals in accordance with the temperature T detected by the

temperature signal from the temperature detector provided in the reaction system, and the predetermined E, R, T_0, α.

The reaction amount could be immediately and easily determined in the operation field by this reaction amount measuring apparatus. However, the reaction amount could not be automatically controlled in accordance with the measured value by this reaction amount measuring apparatus.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a reaction amount measurement controlling apparatus which are capable of measuring the reaction amount with high accuracy and controlling the reaction amount in higher operating efficiency.

It is another object of the present invention to provide a reaction amount measurement controlling apparatus wherein the reaction amount for each given interval is detected in accordance with a temperature signal from one temperature detector disposed in the interior or the outer surface of a reaction system, or in a vessel or container, and each of the reaction amounts is compared with predetermined established reaction amount to generate the output signal when the reaction amount has conformed to the established reaction amount or has exceeded the established reaction amount.

It is another object of the present invention to

provide a reaction amount measurement controlling apparatus which comprises one temperature detector disposed in the interior, the outer surface of the reaction system or in a vessel or container, a computer having an operation function for calculating the reaction amount in accordance with the temperature signal of the temperature detector, and a comparison function for generating an output signal when the reaction amount is equal to a preset amount or exceeds the preset amount, a timer for getting the operation and comparison performed at given intervals.

It is still another object of the present invention to provide a reaction amount measurement controlling apparatus wherein the arithmetic average of a plurality of calculated reaction amount is compared with the preset reaction amount in such a manner that the minimum value or maximum value from among a plurality of reaction amounts is compared with the established reaction amount, whereby insufficient reaction is reduced, the quality is improved as the reaction becomes uniform, and a critical reaction point where an article is gelled is easily found.

It is still another object of the present invention is to provide a reaction amount measurement controlling apparatus wherein a lower bound temperature signal established in a low bound temperature setting device

is compared with a digital temperature setting signal every time the reaction amount is calculated, and when the digital temperature signal is smaller than the low bound temperature signal, the reaction amount at this time is assumed to be zero, thus making it possible to eliminate or at least reduce the error of the calculated equivalence reaction amount.

It is another object of the present invention to provide a reaction amount measurement controlling apparatus, which is preferably applied to measure and control the chemical reaction amount of rubber vulcanization reaction with high accuracy.

These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram, in a first embodiment of the present invention, showing an arrangement of a reaction amount measurement controlling apparatus;

Fig. 2 is a circuit diagram of a starting apparatus for use in the first embodiment;

Fig. 3 is a circuit diagram of a preterminating apparatus for use in the first embodiment;

Fig. 4 is a block diagram, in a second embodiment of the present invention, showing an arrangement of a

reaction amount measuring controlling apparatus;

Fig. 5 is a circuit diagram of a display stopping apparatus for use in the first embodiment,

Fig. 6 is a block diagram showing a modification of Fig. 1; and

Fig. 7 is a block diagram showing a modification of Fig. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is to be noted that the embodiments of the present invention will be described hereinafter in connection with, for example, the vulcanization reaction of rubber to be performed within a metal mold which is adapted to close or open in known manner.

Fig. 1 through Fig. 3 show a first embodiment of an apparatus for automatically measuring and controlling chemical reaction amount in accordance with the present invention.

Referring to Fig. 1, a temperature detector 2 such as thermoelectric couple is inserted into the portion of a reaction system such as the interior of the shoulder portion of a vulcanizing tire or is brought into contact with the outer surface of the shoulder portion or the interior of the reaction vessel or container such as metal mold in a known manner. The temperature detector 2 may generate a temperature signal corresponding to the temperature of

the insertion or contact position with respect to the subject materials. The temperature signal from the temperature detector 2 is fed to an amplification linearizer 4, where it is amplified and rectilinearized. Thereafter, it is converted into a digital temperature signal by an A/D transducer 6 and is fed through an input-output unit 8 to a microcomputer 10.

In addition to the digital temperature signal, a reference temperature T_0 which is preset by an operator in a reference temperature setting device 12, is also fed through an input-output unit 14 to the microcomputer 10. In addition, an active energy E which is set in an active energy setting device 16 is also fed through an input-output unit 18.

The microcomputer 10 is programmed to control the equivalence reaction amount by an Arrhenius' equation (1) or its approximation equation (2) as mentioned above using the digital temperature signal, the reference temperature T_0, and the active energy E; this operation takes place every time a command signal, which is generated by a timer 24 at each of given time intervals, is fed through an input-output unit 26, after a start signal generated by a start signal generator 20 has been fed through an input-output unit 22 to the microcomputer 10. As the start signal generator 20 is used one as shown in Fig. 2.

The start signal generator of Fig. 2 is designed to generate a start signal through the inversion of the voltage variation by an inverter 34; the start signal appears between the two ends of a capacitor 30 and is caused by the discharge of the capacitor 30 through a resistor 28 by a push-button 32 or a limit switch 33, which is designed to close at the same time when a metal mold accommodating a rubber tire to be vulcanized has been closed, or by a pulse signal generator for generating the pulse signal at the same time when the metal mold has been closed. Once the start signal is fed/during the reaction amount calculation by depression of the push-button switch, the microcomputer 10 is programmed to erase all the data so far measured and to start the temperature measurement and the calculation newly from the beginning.

The microcomputer 10 is programmed to perform the comparison, as the equivalence reaction amount is calculated, between the reaction amount in, for example, 90 % vulcanization of rubber supplied through the input-output unit 38 established in the reaction amount setting device 38, the reaction amount in 100 % vulcanization, and each of the calculated equivalence reaction amount so as to feed an output signal to a preterminating apparatus 42 through an input-output unit 40 when it is equal to the reaction amount in the 90 % vulcanization or larger than the reaction amount, and to a terminating apparatus 46 through an input-ouput unit 44 when it is equal to the reaction amount in the 100 % vulcanization or larger than the reaction amount. In cases where the reaction of the subject materials would continue to proceed considerably even after the opening of the metal mold, as for instance in the case of tires, the preterminating apparatus 42 is designed to open the metal mold earlier.

The preterminating apparatus 42 is constructed as shown in Fig. 3. In Fig. 3, an output signal fed from the input-output unit 40 is inverted by an inverter 48. The transistor 50 is conducted by the inversion output to operate a relay 52 to close a contact 54 to light a light-emitting diode 56 and to close a contact 58

to open the metal mold. Also, the output signal may be fed to a pulse generating apparatus (not shown) to generate pulses for use in the other apparatus. It is to be noted that an operator may open the metal mold with a free hand after the light emitting diode has been lit. The terminating apparatus 46, as in the preterminating apparatus 42, is adapted to light the light-emitting diode, to generate the contact signal or to generate the pulse. Accordingly, in the case of such a rubber vulcanization reaction, the contact 58 of the preterminating apparatus 42 is closed by the condition of the 90 % vulcanization to automatically or manually open the metal mold. If the rubber is taken out from the metal mold at lighting of the light-emitting diode of the terminating apparatus 46 by the condition of the 100 % vulcanization, the reaction amount can be controlled extremely correctly.

The micro computer 10 is programmed so that a reaction amount signal is fed through an input-output unit 62 to a reaction amount display 60, each time the reaction amount is calculated, to display the reaction amount, a digital temperature signal at that time is fed through an input-output unit 66 to the temperature display 64, each time the reaction amount is calculated, to display the temperature, furthermore a signal representing the lapse of the time from the reaction start is fed

through an input-output unit 68 to a time display 70 to display the time from the reaction start. It is to be noted that the microcomputer 10 is also programmed so that the display may be stopped by the display stop apparatus 100. As shown in Fig. 5, the display stop apparatus 100 is adapted to close a manual switch 103, and a limit switch 104 which is adapted to close when the metal mold opens, to discharge the electric charge of a capacitor 102. Also, a pulse signal generator (not shown) for generating pulse signals when the metal mold opens is adapted to discharge the electric charge of a capacitor 102 through a resistor 101. Change in the voltage caused thereby across the capacitor 102 is inversed by an inverter 105 and is fed to the microcomputer 10 through the input-output unit 106. Even if the display is stopped by the display stop apparatus 100, the microcomputer 10 is performing the operation for continuously calculating the reaction amount, and, when the manual switch 103 and the limit switch 104 have been opened, or when the pulse from pulse signal generator has stopped, the present reaction amount calculated within the microcomputer 10 is displayed. Also, the reaction amount and the measured temperature can be printed, through an input-output unit 73, on the printer 72. Generally, as the temperature measurement and the calculation are performed

more frequently, the accuracy of controlling the reaction amount becomes higher, approximating the predetermined value. The data to be outputted by the printer 72 need not be outputted as many times as temperature measurement frequency and the calculation frequency of the reaction amount. Assume that the frequency, which has been set in a printing frequency setting device 74 is, for example, "2", then the data is printed every time the reaction quantity is calculated twice. It is to be noted that the printing is performed every time "1" is set.

Also, a lower bound temperature signal, which is set in a lower bound temperature setting device 76, is fed through an input-output unit 78 to the microcomputer 10. The microcomputer 10 is designed to compare a digital temperature signal with a lower bound temperature signal every time the reaction amount is calculated. When the digital temperature signal is lower than the lower bound temperature signal, the microcomputer is programmed so that the reaction amount at this time point is 0, namely, the reaction amount is not calculated. For instance, it is well known that in the case of large bulk reaction amounts as in tires, it takes longer to raise the temperature of the tire and the low temperature condition for the tire is maintained for a long time. According to the calculation of the equivalence reaction amount by the

Arrhenius equation (1) or its approximation equation (2), the equivalence reaction amount is small in the case of relative low temperature, but the error between the actual amount and the expected amount becomes considerably larger in the case of long reaction time due to the cumulative total of the time. To remove the error, the reaction amount at that time is assumed to become 0 when the digital temperature signal is lower than the low bound temperature signal.

As mentioned above, the apparatus of the first embodiment comprises at least one temperature detector disposed in the interior, the outer surface of the reaction system or in a container, a computer having an operation function for calculating the reaction amount in accordance with the temperature signal of the temperature detector, and a comparison function for generating an output signal when the reaction amount is equal to a preset amount or exceeds the preset amount, a timer for getting the operation and comparison functions performed at given intervals. The apparatus is adapted to perform the steps of detecting the reaction amount for each given interval in accordance with a temperature signal from one temperature detector disposed in the interior or the outer surface of a reaction system, or in a container, and comparing each of the reaction amounts with a predetermined established reaction amount to generate the output signal when the

reaction amount is equal to the established reaction amount or exceedes the established reaction amount, thereby producing an effect which makes it possible to measure the reaction amount with high accuracy and to control the reaction amount.

Fig. 4 is a block diagram of a second embodiment of an apparatus according to the present invention. In a first embodiment, there is only one temperature dectector 2, but in a second embodiment, a plurality of, for example, six temperature detectors 2a through 2f are provided within a reactive system. The temperature detectors 2a through 2f are different from each other in that they are inserted into the interiors of the respective different positions, for instance, along the peripheral direction of the shoulder portion of the vulcanizing tire or they are kept in contact with the outer surface of the different position or with the interior of a metal mold corresponding to the different position. Each of the temperature signals from the temperature detectors 2a through 2f are rectilinearized and amplified by an amplifier linearizer 4 through a multiplexer 80. Thereafter, it is converted into a digital temperature signal by an A/D transducer 6 and is fed to the microcomputer 10 through an input-output unit 8. It is to be noted that the microcomputer 10 is programmed to load it every time a digital temperature

signal is fed in which corresponds to the temperature signal of the temperature detectors such as 2a, 2c, 2e selected by a channel number selector signal which is fed through an input-output unit 84 from the channel number selector switch 82, to thereby calculate the equivalence reaction amount of the positions where the temperature detectors 2a, 2c, 2e are provided in accordance with a digital temperature signal, reference temperature signal and an active energy signal. The combinations of temperature detectors 2a through 2f are [(2^6 - 1) = 63] in number. Also, this calculation for the equivalence reaction amount is performed after the start signal has been generated and when the timer 24 is transmitting a command signal.

Also, the microcomputer 10 is programmed so that the arithmetic average of each of the equivalence reaction amounts of positions where temperature detectors such as temperature detectors 2a, 2c, 2e selected by a channel number selector 82 are provided may be obtained, or the maximum and the minimum of the respective equivalence reaction amount or the reaction amount of the specified channel may be selected. The realization of the arithmetic averages or the selection of the maximum or the minimum to the equivalence reaction amount or the reaction amount is determined by a selector signal fed to the microcomputer 10 through an input-output unit 88 from the selector switch 86.

The microcomputer 10 is programmed so that an output signal is fed to a preterminating apparatus 42

when it is equal to the reaction amount in 90 % vulcanization or larger than the reaction amount, and to a terminating apparatus 46 when it is equal to the reaction amount in 100 % vulcanization or larger than the reaction amount, through comparison of the arithmetic average value, the maximum value, minimum value or the reaction amount at a measurement point selected by a selector switch 86 with the set value of the reaction amount setting device 36 as in the first embodiment. The construction of the other embodiments is the same as that of the first embodiment except that a channel number display 90 is adapted to display a sensor selected by a channel number selector 82 and an input-output unit 92 is provided for the channel number display.

In the above construction, it is to be noted that the reaction amount measurement controlling apparatuses of the present invention calculate the reaction amount each time a given time has elapsed and compares the calculated reaction amount with the preset reaction amount in displaying and printing the reaction amount. The reaction can be automatically controlled with respect to the subject material, thus resulting in higher operating efficiency for the reaction amount. Particularly in a second embodiment, the arithmetic average of a plurality of calculated reaction amounts can be compared with the preset reaction amount. Thus, as compared to

a case where the reaction amount is one as described in the first embodiment, the accuracy of the reaction amount becomes higher, so that the reaction control such as vulcanization accuracy is improved in the second embodiment. In the second embodiment, as the minimum value from a plurality of reaction amounts can be compared with the established reaction amount, insufficient reaction is removed and the quality is improved, thus resulting in uniform reaction. Also, as the maximum value from a plurality of reaction amount can be compared with the established reaction amount, a critical reaction point where an article is gelled can be easily found, thus improving reaction accuracy.

In addition, the reaction amount measurement controlling apparatuses of the present invention compare a lower bound temperature signal produced by a low bound temperature setting device 76 with a digital temperature setting signal every time the reaction amount is calculated. When the digital temperature signal is smaller than the low bound temperature signal, the reaction amount at this time is assumed to be 0 to eliminate or at least reduce the error as described in the first embodiment. If the digital temperature signal is relatively smaller, the equivalence reaction amount calculated by an Arrhenius' reaction speed equation (1) or its approximation equation (2) becomes an extremely small value. However, when the reaction time t is long due to accumulation through time, the calculated

equivalence reaction amount contains a considerable error. To remove the error, the reaction amount is assumed to be 0 when the digital temperature signal is lower than the low bound temperature signal. Accordingly, as the reaction amount can be calculated with high accuracy, the controlling accuracy of the reaction amount is improved.

Also, as a start signal generating apparatus 20 is provided in the both described embodiments, the measurement, calculation and controlling can be automatically started when the vulcanizing press is closed. By the closure of the push-button switch 32 of the start signal generating apparatus 20, all the data so far measured can be erased so that the temperature measurement, calculation and controlling can be newly started. In both embodiments, a printing frequency setting device 74 is provided, and the measured temperature, and the reaction amount are printed for each established frequency of the measurement, and the calculation performed. In the above-described embodiments, a thermoelectric couple was used as a sensor, while platinum resistor or the like can be used in place of the thermoelectric couple.

Although the present invention has fully been described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. By way of example, the concept of the present invention can be

applied not only to the apparatus for automatically measuring and controlling chemical reaction amount such as described, but also any other type of apparatuses as shown in Figs. 6 and 7, wherein certain components such as the terminating apparatus, preterminating apparatus, reaction amount setting apparatus can be eliminated from the apparatuses of Figs. 1 and 4, respectively, if they are not necessary for operation.

Fig. 6 shows a reaction amount measurement controlling apparatus comprising at least one temperature detector disposed in the interior, the outer surface of the reaction system or in a container, a computer having an operation function for calculating the reaction amount in accordance with the temperature signal of said temperature detector, and a stop function for terminating said operation function when said temperature signal is lower than the predetermined low bound temperature value. Also, Fig. 7 shows a reaction amount measurement controlling apparatus comprising at least one temperature detector disposed in the respective different positions in the interior, the outer surface of the reaction system or in the vessel, a multiplexer for receiving the temperature signal from said temperature detector, a microcomputer having an operation function for calculating the reaction amount in accordance with the temperature signal from said multiplexer, a stop function for terminating said operation

function when said temperature signal is lower than the predetermined low bound temperature value, an average function for obtaining the arithmetic average of each of the reaction amounts, and a selection function for selecting the maximum and the minimum of the reaction amounts, and a selection switch for selecting the outputs from said functions of the microcomputer.

What is claimed is:

1. A reaction amount measurement controlling apparatus comprising at least one temperature detector disposed in the interior, the outer surface of the reaction system or in a vessel, a computer having an operation function for calculating the reaction amount in accordance with the temperature signal of said temperature detector, and a comparison function for generating an output signal when said reaction amount is equal to a pre-set amount or exceeds said preset amount.

2. A reaction amount measurement controlling apparatus in accordance with Claim 1, wherein said computer has switches for starting the actuation of said operation function and comparison function.

3. A reaction amount measurement controlling apparatus in accordance with Claims 1 and 2, wherein said computer has a printer, which for each set value of a printing frequency setting device prints the respective reaction amounts sequentially calculated.

4. A reaction amount measurement controlling apparatus in accordance with Claims 1 through 3, wherein said computer is designed to cease said operation function when said temperature signal is lower than a predetermined low bound temperature.

5. A reaction amount measurement controlling apparatus comprising at least one temperature detector

provided in the interior, the outer surface of a reaction system or in the vessel, a microcomputer having an operation function for calculating the reaction amount in accordance with the temperature signal of said temperature detector and a comparison function for generating an output signal, which terminates the reaction when said reaction amount is equal to a predetermined reaction amount or exceeds said predetermined reaction amount, a timer for getting said operation and comparison performed at given intervals, and at least a printer for printing said reaction amount.

6. A reaction amount measurement controlling apparatus in accordance with Claim 5, wherein said microcomputer has switches for starting the actuation of said operation function and comparison function.

7. A reaction amount measurement controlling apparatus in accordance with Claim 5, wherein for each of the set values of a printing frequency setting device, said printer prints the respective reaction amounts sequentially calculated.

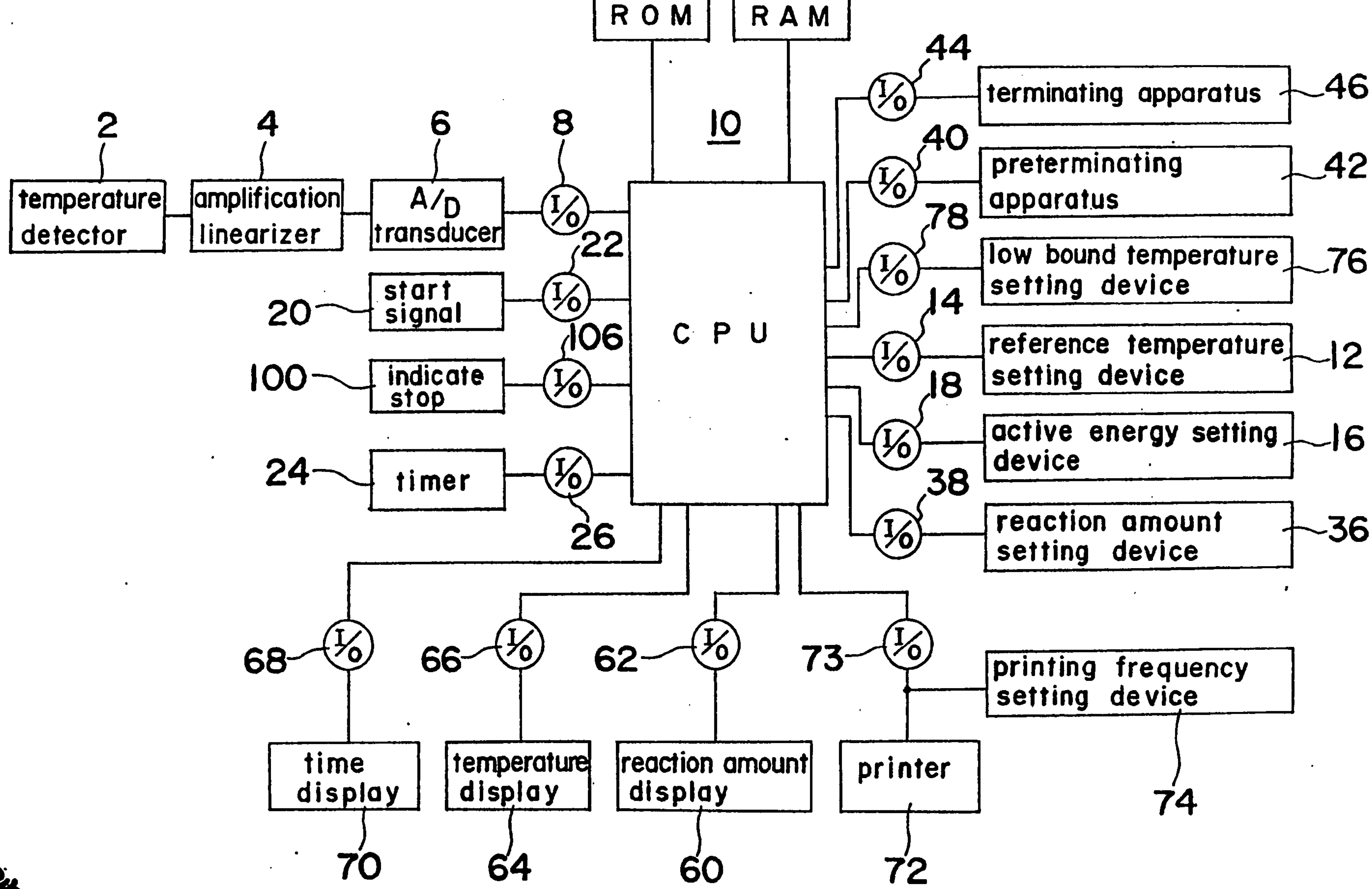
8. A reaction amount measurement controlling apparatus in accordance with Claim 5, wherein said temperature detector is disposed in the respective different positions in the interior, the outer surface of said reaction system or in the container.

9. A reaction amount measurement controlling apparatus

apparatus comprising at least one temperature detector disposed in the interior, the outer surface of the reaction system or in the vessel, a microcomputer having an operation function for calculating the reaction amount in accordance with the temperature signal from said temperature detector, a comparison function for generating an output signal, which terminates the reaction when said reaction amount is equal to the predetermined set reaction amount or exceeds said reaction amount, and a stop function for terminating said operation function when said temperature signal is lower than the predetermined low bound temperature value, a timer for getting said operation and comparison performed at given intervals, and a printer for printing said reaction amount.

10. A reaction amount measurement controlling apparatus in accordance with Claim 9, wherein said temperature detector is provided in the respective different positions in the interior, the outer surface of said reaction system or in the container.

Fig. 1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RAM
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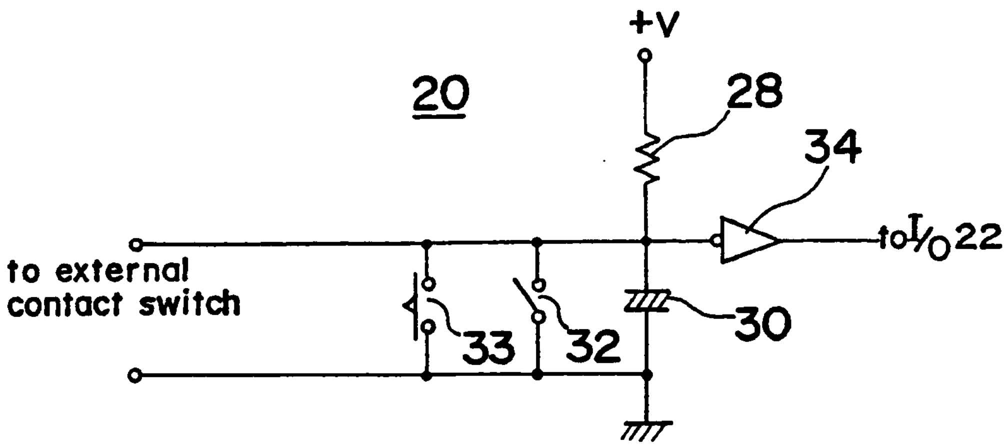
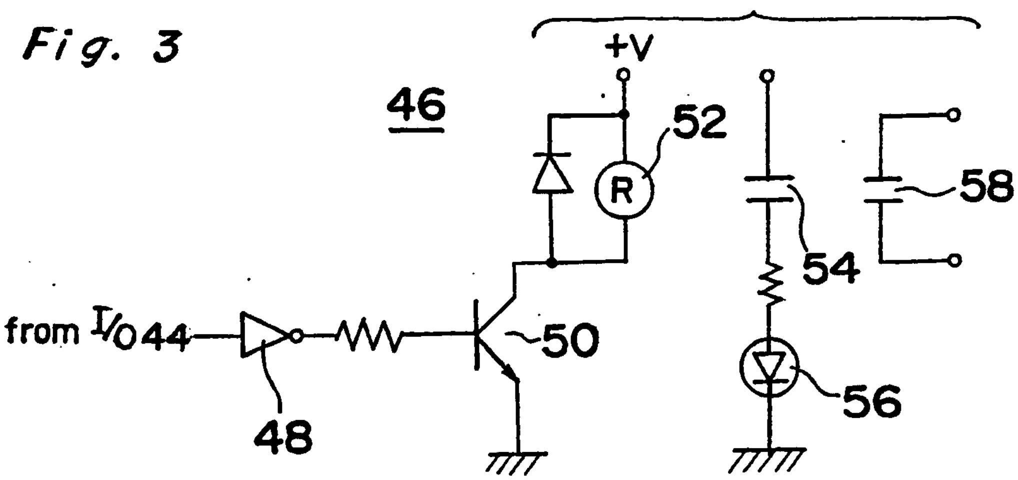
CPU
temperature detector
2
amplification linearizer
4
A/D transducer
6
8
start signal
20
22
indicate stop
100
106
timer
24
26
terminating apparatus
46
44
preterminating apparatus
42
40
low bound temperature setting device
76
78
reference temperature setting device
12
14
active energy setting device
16
18
reaction amount setting device
36
38
printing frequency setting device
74
73
printer
72
reaction amount display
60
62
temperature display
64
66
time display
70
68

Fig. 2



+V
20
28
34
to external
contact switch
33
32
30
to I/O 22

Fig. 3



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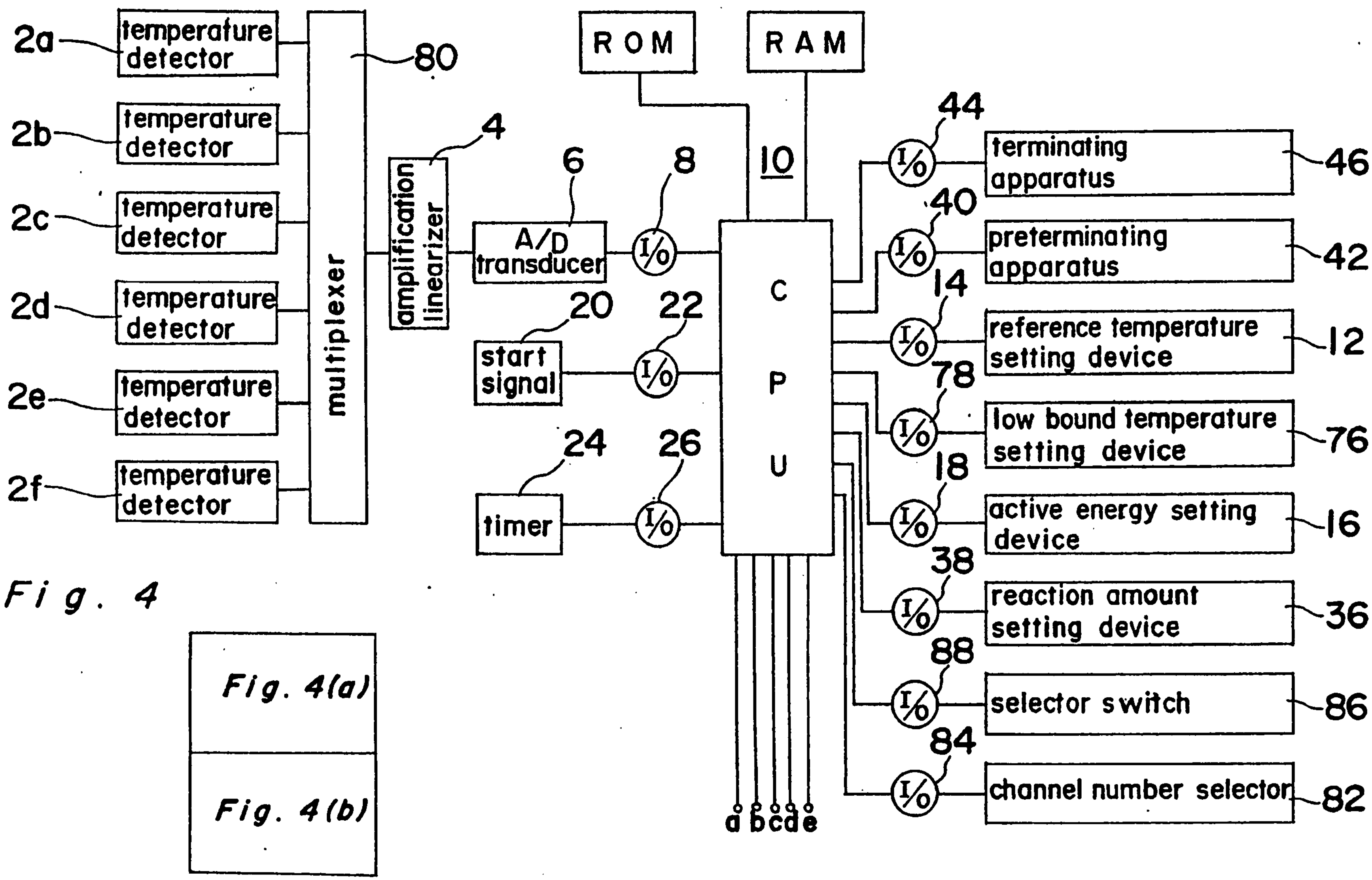
52
R
58
54
from I/O 44
50
56
48

Fig. 4(a)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temperature detector
temperature detector
temperature detector
temperature detector
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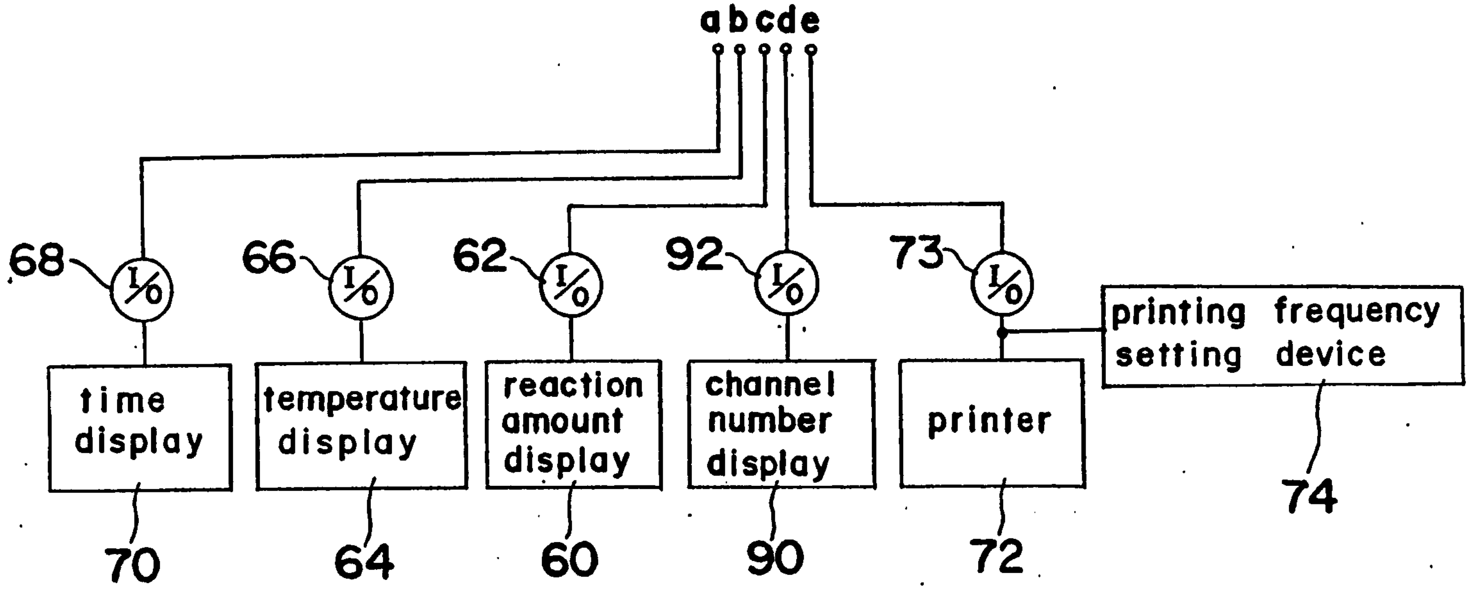
A/D transducer
6
8
start signal
20
22
timer
24
26
ROM
RAM
10
C P U
a b c d e
44
terminating apparatus
46
40
preterminating apparatus
42
14
reference temperature setting device
12
78
low bound temperature setting device
76
18
active energy setting device
16
38
reaction amount setting device
36
88
selector switch
86
84
channel number selector
82
Fig. 4(a)
Fig. 4(b)

Fig. 4

Fig. 4(b)


a b c d e
68
66
62
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73
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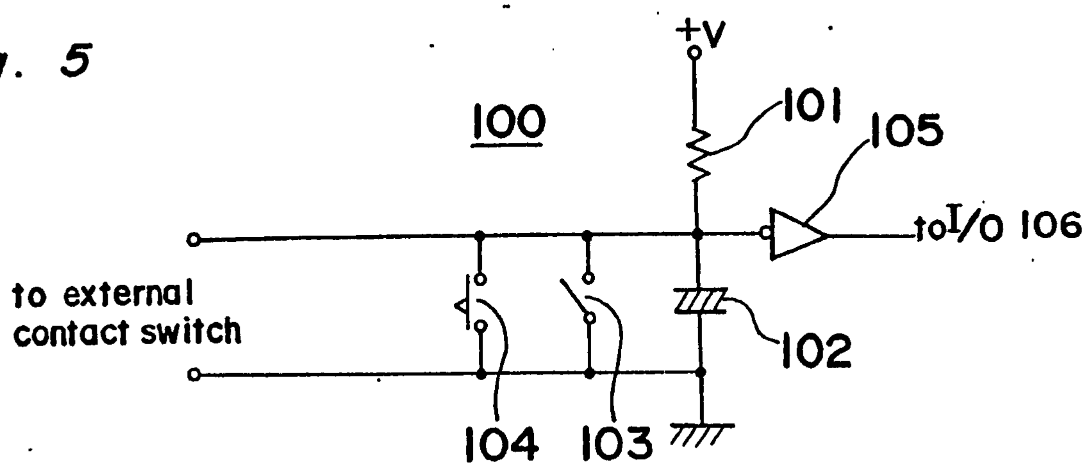
time display
temperature display
reaction amount display
channel number display
printer
74
70
64
60
90
72

Fig. 5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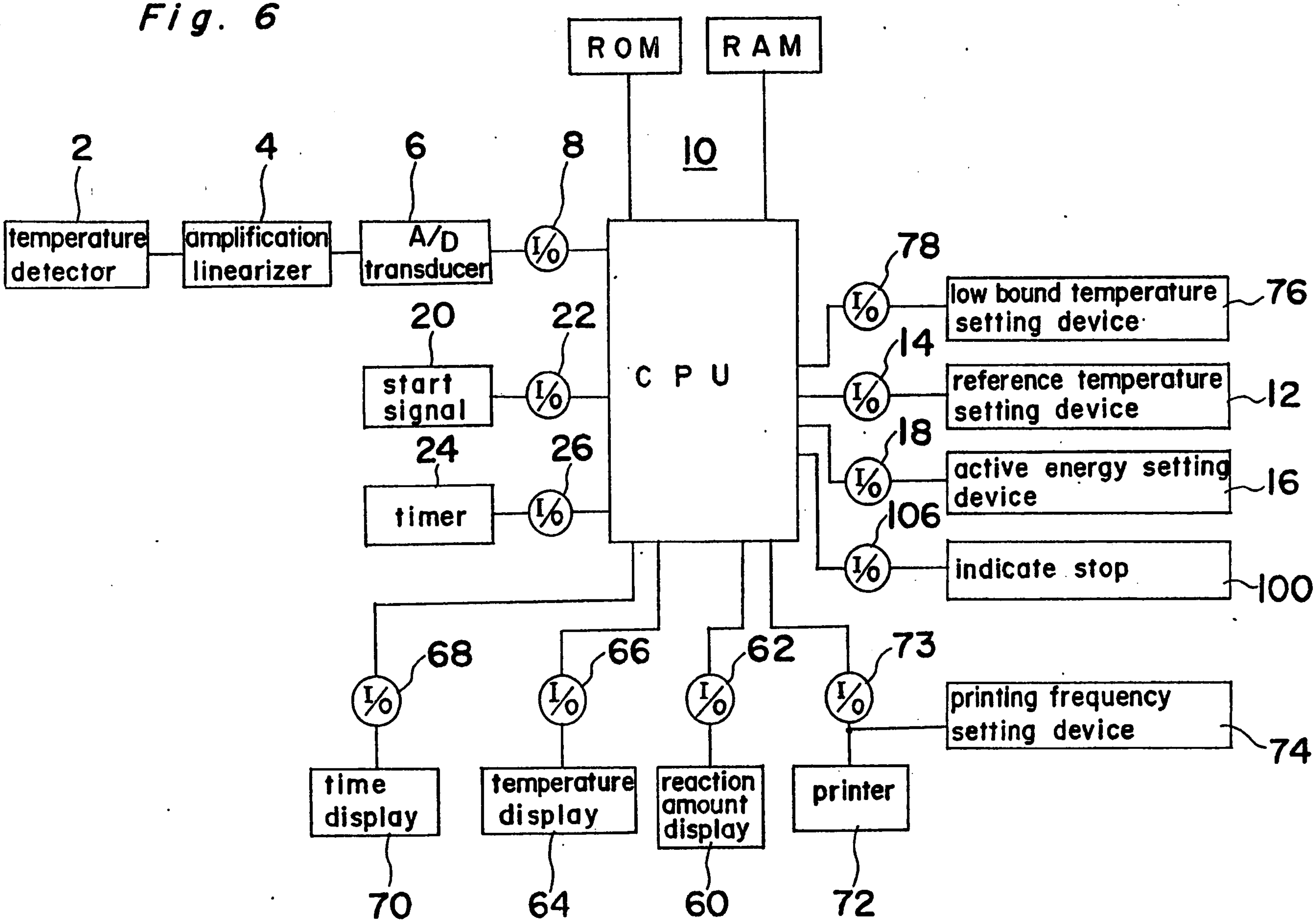
to I/O 106
to external contact switch
102
104
103

Fig. 6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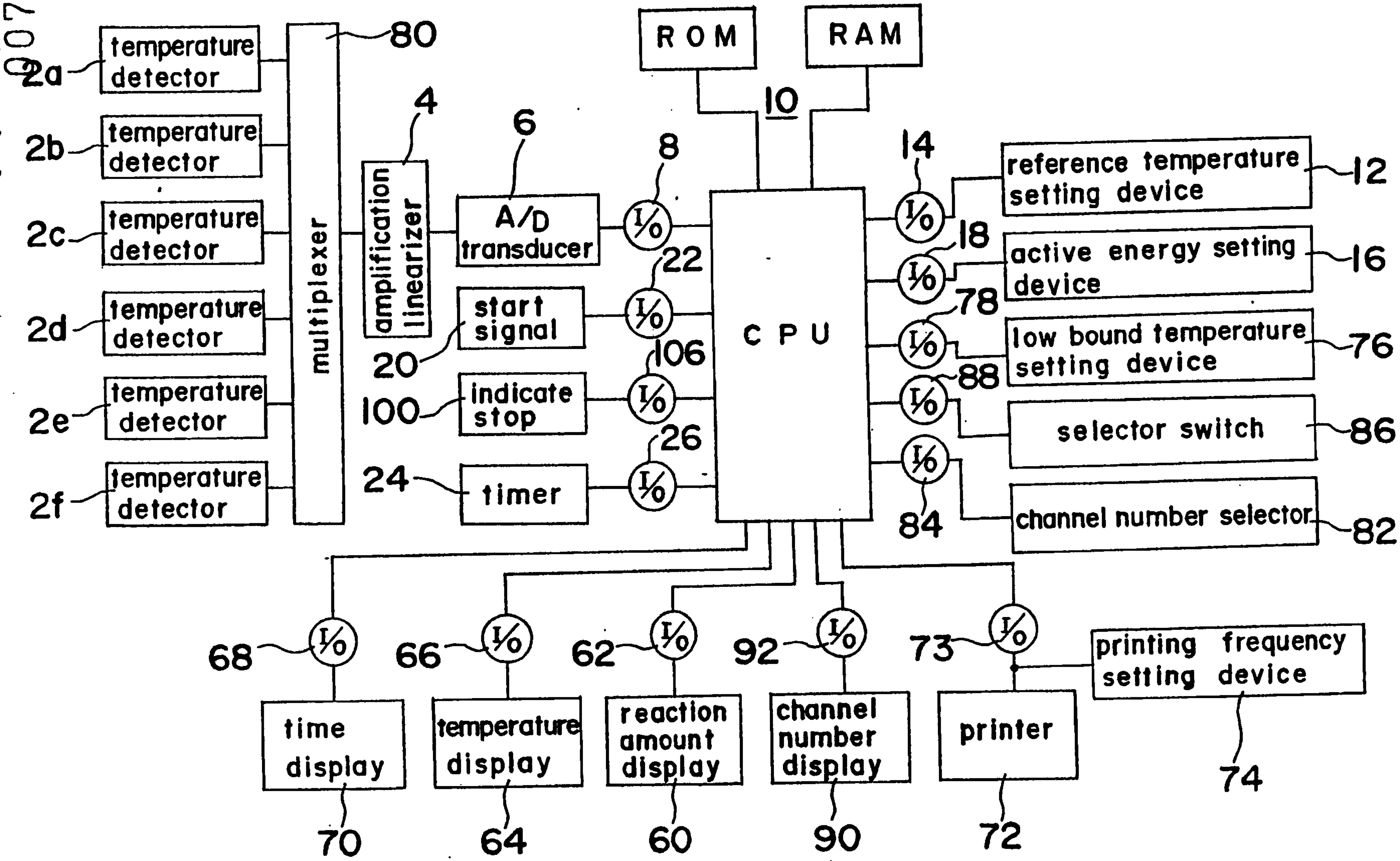
26
low bound temperature setting device
76
78
reference temperature setting device
12
14
active energy setting device
16
18
indicate stop
100
106
printing frequency setting device
74
73
time display
70
68
temperature display
64
66
reaction amount display
60
62
printer
72

Fig. 7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2b
2c
2d
2e
2f
multiplexer
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amplification linearizer
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A/D transducer
6
start signal
20
indicate stop
100
timer
24
8
22
106
26
ROM
RAM
10
CPU
14
18
78
88
84
reference temperature setting device
12
active energy setting device
16
low bound temperature setting device
76
selector switch
86
channel number selector
82
68
66
62
92
73
time display
70
temperature display
64
reaction amount display
60
channel number display
90
printer
72
printing frequency setting device
74

European Patent Office

EUROPEAN SEARCH REPORT

0071988 Application number

EP 82 10 7094

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X,Y	US-A-3 819 915 (T.W.SMITH) *column 2, line 36 to column 7, line 30; figures 1,2*	1-10	B 01 J 19/00 G 05 D 21/02 // B 29 H 5/24
X,Y	GB-A-1 293 941 (DUNLOP HOLDINGS) *Page 1, line 41 to page 5, line 7; figure*	1-7	
X,Y	GB-A-1 479 700 (FEDERAL-MOGUL) *Page 2, lines 6 to 41; page 3, lines 25 to 126; page 4, line 66 to page 5, line 15; figures 1,3A*	1,2,6	
Y	US-A-3 659 974 (E.J.NEUGROSCHL) *Column 3, lines 26 to 72; figure 2*	3,5,7	**TECHNICAL FIELDS SEARCHED (Int. Cl. 3)**
Y	GB-A-1 165 671 (DUNLOP CO.) *Page 1, lin 41 to page 2, line 87*	4,9	B 29 H 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05-11-1982	POINT A.G.F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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